White Beam Synchrotron Topographic Studies of Micropipe Filling Growth of SiC

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Beamline(s): **X19C**

The importance of SiC for high temperature, high power and high frequency semiconductor devices has been well established. However, the extent of the implementation of materials such as 6H and 4H SiC is limited by the presence of hollow-core screw dislocations, known as micropipes, which are produced during the growth process. The development of strategies for the elimination of these defects is therefore of utmost importance. One such strategy, adopted by Technologies and Devices International (TDI), Inc. is to grow a thin film on the surface of a substrate wafer containing micropipes, using liquid phase epitaxy. During the growth of the thin film, the dislocation hollow cores, or micropipes, are filled. However, the detailed nature of this process has not yet been revealed. For example, does the process modify the dislocation strain field? This question we have endeavored to answer using SWBXT. To this end, a 4H-SiC wafer was examined before and after the TDI process, to investigate any potential changes in the screw dislocation (both closed-core and hollow-core) contrast. Figure 1 shows a g=00016 back-reflection topograph recorded from the 2-inch 4H-SiC sample before the TDI process, while figure 2 shows a corresponding image recorded after. Close examination of figure 1 reveals closed core screw dislocations, individual (M) and groups (G) of micropipes, and subgrain boundaries (S), exhibiting tilts of just a few arc seconds. The density of dislocations with Burgers vectors in the range 1c-2c is estimated to be around 10^{+4}cm^{-2}. Comparison with figure 2 reveals that all of these features are essentially unchanged. The dislocation images are generally clearer in figure 2, but this is probably attributable to the fact that this topograph is recorded from an as-grown surface, whereas figure 1 was recorded from a polished surface. Small degrees of residual polishing damage would be enough to explain the slight overall contrast differences. Examination of specific contrast features associated with micropipes reveals that no change in contrast shape, size or intensity distribution is observed. This would indicate that the strain fields associated with the micropipes are unchanged by the micropipe filling process.

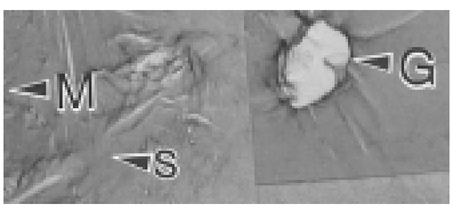

Figure 1 White Beam Synchrotron g=00016 Back-Reflection Topograph (before the TDI process)

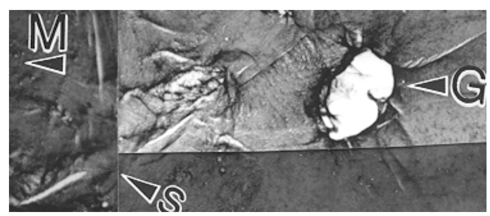

Figure 2 White Beam Synchrotron g=00016 Back-Reflection Topograph (after the TDI process)